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Polychaete assemblages in the Argentinean Biogeographical Province, between 34° and 38°S

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SUMMARY: Polychaete assemblages were studied from samples taken in the Southwestern Atlantic, between 34°S and 38°S (Argentinean Biogeographical Province) during 1993, 2001 and 2002 from a series of oceanographic cruises in mixohaline to oceanic waters. Polychaetes represented almost 25% (number of taxa) of the macrobenthic assemblages; 57 taxa corresponding to 29 families were identified. The MDS plot shows an ordination of samples according to the following areas: the central estuary and mouth of Río de la Plata (group 1), the coastal shelves of Uruguay and Argentina and the transect off the mouth of Río de la Plata (groups 2 and 3) and other coastal stations from both countries (groups 4 and 5). The abiotic variable that best explained the distribution pattern (BIO-ENV analysis) was the bottom salinity, while the best combination included 2 variables: bottom salinity and type of bottom. Trophic diversity increased with salinity. The distributional range of four species: *Sabellaria bellis* Hansen, 1882; *Travisia amadoi* Elías *et al*., 2003a: *Terebellides lanai* Solis-Weiss *et al*., 1991 and *Aglaophamus uruguayi* Hartman, 1953, was extended.

Keywords: benthos, polychaetes, assemblages, SW Atlantic.

RESUMEN: AGRUPACIONES DE POLIQUETOS EN LA PROVINCIA BIOGEOGRÁFICA ARGENTINA, ENTRE 34° Y 38°S. – Se estudiaron las agrupaciones de poliquetos a partir de muestras recogidas en el Atlántico Sudoccidental, entre 34ºS y 38ºS (Provincia Biogeográfica Argentina) durante los años 1993, 2001 y 2002, en el marco de campañas oceanográficas llevadas a cabo desde aguas mixohalinas hasta marinas. Los poliquetos representan casi el 25% (número de taxones) de la agrupación macrobentónica; fueron identificados 57 taxones pertenecientes a 29 familias. El ordenamiento multidimensional (MDS) de estaciones distingue diferentes áreas: estuario central y boca del Río de la Plata (grupo 1), plataformas costeras de Uruguay y Argentina, y transecta fuera del Río de la Plata (grupos 2 y 3) y otras estaciones costeras de ambos países (grupos 4 y 5). La variable abiótica que mejor explicó el patrón de distribución (análisis BIO-ENV) fue la salinidad de fondo; la mejor combinación incluyó dos variables: salinidad de fondo y tipo de fondo. La diversidad trófica incrementó con la salinidad. Se extiende el rango de distribución de cuatro especies: *Sabellaria bellis* Hansen, 1882, *Travisia amadoi* Elías *et al*., 2003a, *Terebellides lanai* Solis-Weiss *et al*., 1991 y *Aglaophamus uruguayi* Hartman, 1953.

Palabras clave: bentos, poliquetos, asociaciones, Atlántico Sudoccidental.

INTRODUCTION

Few studies on benthic polychaetes have been undertaken in the Southwestern Atlantic, especially given the wide geographical area involved. As a result, the group has been excluded from previous analyses of the structure and spatial distribution of benthic communities in the Argentine Sea (i.e. Bastida *et al*., 1992). Currently, the presence of polychaetes in southern regions is mainly monitored as part of the benthic assemblages in areas subjected to different anthropogenic impacts: trawling fisheries (e.g. Bremec and Lasta, 2002; Roux *et al*., 2002, 2005) or pollution (e.g. Elías and Bremec, 1994; Elías *et al*., 2004).

Our study area comprises the Uruguayan and northern Argentinean shelves, both belonging to the Argentinean Biogeographical Province (Boschi, 2000a). Polychaetes from these areas were studied in the past decades (e.g. Orensanz, 1972; 1976; Orensanz and Gianuca, 1974; Rullier and Amoureux, 1979). More recently, Salazar-Vallejo and Orensanz (1991), Lana and Bremec (1994), Bremec and Elías (1999), Elías and Bremec (1997, 2003), Elías *et al*. (2000, 2003b) and Palacios *et al*. (2005) provided taxonomical information on many other families, both for the present area as well as for a wider range from Patagonia to southern Brazil.

In this paper we analyse macrobenthic samples taken between 34°S and 38°S, in 1993, 2001 and 2002 during oceanographic surveys in mixohaline to oceanic waters. This contribution provides a preliminary characterisation of local polychaete assemblages and extends biogeographic knowledge of the polychaete fauna in the Argentinean Biogeographical Province.

MATERIALS AND METHODS

The material studied was collected at 49 stations, between 34 and 38ºS, in a depth range of 8-270 m (Fig. 1). Samples were obtained during 3 surveys: cruise EH-09-1993 (epibenthic sledge, 200 × 50 cm mouth opening, soft bottoms); cruise EH-09-2001 (Picard dredge, 65 × 20 cm mouth opening, in sandy bottoms and van Veen grab, 0.1 m^2, in muddy bottoms); cruise CC-02-2002 (rectangular dredge, 2.5 × 0.5 m mouth opening, in gravel-sandy bottoms of a mussel bed and a lemon-fish feeding ground). As different gears were used to collect the samples from different types of bottoms, we present the results in terms of the relative abundance of the taxa found.

Benthic samples were sieved (0.5 mm mesh screen) and specimens were fixed in 4% formalin, preserved in 70% alcohol and identified to the lowest taxonomic level possible. In order to indicate the relative proportion of polychaetes within the benthic assemblages the total number of taxa of the major invertebrate groups was summed and the percentage of taxa of each group was estimated for the 3 surveys.

Cluster analysis (Bray-Curtis similarity index, UPGMA, Q mode) (Clarke and Warwick, 1993) and non-metric multidimensional scaling (MDS) (Clarke, 1993) were applied to the 4th root transformed relative abundance (each species count divided by the total abundance per sample) of poly-

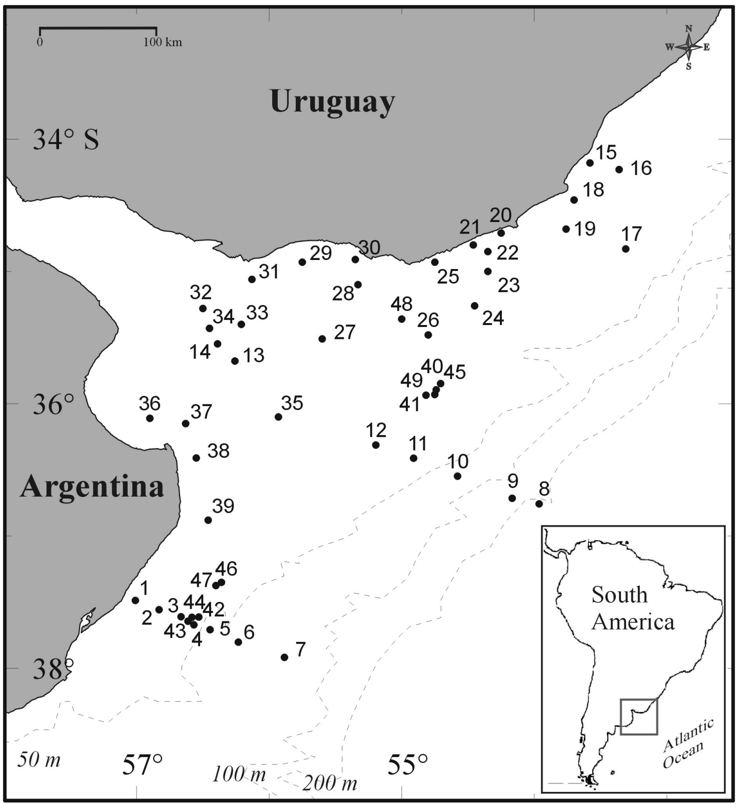

FIG. 1. – Location of the 49 sampling stations between 34°S and 38°S.

TABLE 1. – Depth, bottom temperature, bottom salinity and bottom type of the sampling stations between 34ºS and 38ºS.

Station	Depth (m)	Bottom temperature (°C)	Bottom salinity(psu)	Bottom type
1	11,5	16.782	31.114	sandy
2	20	14.973	32.088	sandy
3	33	14.736	32.407	sandy
4	44	12.8865	32.9025	sandy
5	54	11.037	33.398	sandy
6	74	10.262	33.589	sandy
7	79	8.145	33.609	sandy
8	270	4.705	34.094	sandy
9	125	7.007	33.757	sandy
10	60	9.257	33.603	sandy
11	46	12.019	33.240	sandy
12	24	14.575	32.270	sandy
13	10	19.348	18.971	muddy
14	8	19.507	17.100	muddy
15	15	12.949	20.285	sandy
16	26	13.095	32.363	sandy
17	39	11.558	33.468	sandy
18	23	12.607	31.526	sandy
19	37	11.139	33.442	sandy
20	22	10.098	29.991	sandy
21	21	11.480	33.532	sandy
22	31	10.297	32.247	sandy
23	36	12.098	29.629	sandy
24	25	11.435	33.571	sandy
25	23	10.290	30.788	sandy
26	27	11.833	33.759	sandy
27	20	10.239	32.108	sandy
28	22	10.542	30.226	muddy
29	8	11.281	15.056	muddy
30	14	11.399	13.715	muddy
31	11	11.054	13.101	muddy
32	9	10.350	14.655	muddy
33	11	9.726	20.235	muddy
34	14	9.274	21.633	muddy
35	15	9.025	33.750	muddy
36	11	9.850	32.988	muddy
37	17	9.750	33.568	muddy
38	18	9.780	33.246	sandy
39	21	9.500	33.705	sandy
40	27	19.940	32.690	sandy-gravel
41	25	19.590	32.680	sandy-gravel
42	38	19.780	33.350	sandy-gravel
43	38	19.780	33.400	sandy-gravel
44	38	19.780	33.350	sandy-gravel
45	24	19.793	32.690	sandy-gravel
46	24	19.780	33.350	sandy-gravel
47	36	19.780	33.350	sandy-gravel
48	22	10.484	33.736	sandy
49	25	19.850	32.700	sandy-gravel

chaetes. The SIMPER analysis (Clarke, 1993) was used to identify which species contributed most to the similarity between samples. Stations 48 and 49, where only one polychaete taxon was collected, were excluded from the data matrix.

The classification of taxa into trophic categories was based on Fauchald and Jumars (1979), following the general trophic assumptions adopted in similar investigations worldwide (Muniz and Pires, 1999; 2000; Hutchings and Peyrot-Clausade, 2002; Arasaki *et al*., 2004; Hughes and Gage, 2004). Cluster analysis (Bray-Curtis similarity index, UPGMA, Q mode) was applied to the presence-absence data of trophic categories (carnivore, deposit-feeder, omnivore, filter/suspension feeder) .

Environmental data (Table 1) were taken from Giberto *et al*. (2004, EH-09-1993) and Giberto and Bremec (2003a, b, EH-09-2001 and CC-02-02 respectively). The BIO-ENV analysis was used to determine which set of variables (bottom salinity, depth, bottom temperature, type of bottom, similarity calculated with the Euclidean distance coefficient) best explains biological variation patterns (relative abundance data using Bray-Curtis similarity measure) (Clarke and Ainsworth, 1993; Clarke and Warwick, 2001).

TABLE 2. – List of taxa and their feeding types found between 35°S-38°S during the cruises in 1993, 2001 and 2002. (DF, deposit feeder; FF/SS, filter/suspension feede; CC, carnivore; OM, omnivore).

Taxa	Feeding type
ORBINIIDAE	
Orbiniidae unid.1	DF
SPIONIDAE	
Spionidae unid.1	DF
MAGELONIDAE	
Magelona riojai Jones, 1963	DF
CHAETOPTERIDAE	
Phyllochaetopterus socialis Claparède, 1870	FF/SS
Chaetopteriidae unid.1	FF/SS
CIRRATULIDAE	
Cirratulidae unid.1	DF
CAPITELLIDAE	
Capitella sp.	DF
MALDANIDAE	
Maldanidae unid.1	DF
OPHELIIDAE	
Armandia loboi Elías and Bremec, 2003	DF
Travisia amadoi Elías *et al*., 2003	DF
PHYLLODOCIDAE	
Phyllodocidae unid.1	CC
APHRODITIDAE	
Aphrodita longicornis Kinberg, 1855	CC
Aphroditella alta (Kinberg, 1855)	CC
POLYNOIDAE	
Lagisca sp.	CC
Polynoidae unid.1	CC
SIGALIONIDAE	
Sigalion cirriferum Orensanz and Gianuca, 1974	CC
SYLLIDAE	
Syllidae unid.1	CC
NEREIDIDAE	
Neanthes succinea (Frey and Leuckart, 1847)	OM
Nereididae unid.1	OM
GLYCERIDAE	
Glycera americana Leidy, 1855	CC
Glyceridae unid.1	CC
GONIADIDAE	
Goniadidae unid.1	CC
NEPHTYIDAE	
Nephtys sp.	CC
Aglaophamus uruguayi Hartman, 1953	CC
Nephtyidae unid.1	CC
ONUPHIDAE	
Diopatra viridis Kinberg, 1865	OM
Diopatra sp.	OM
Onuphis aff. eremita Audouin and Milne Edwards, 1834	OM
Onuphis tenuis Hansen, 1881	OM
Onuphis sp.	OM
Onuphidae unid.1	OM
EUNICIDAE	
Eunice argentinensis (Treadwell, 1929)	CC
Eunice magellanica McIntosh, 1885	CC
Eunicidae unid.1	CC
LUMBRINERIDAE	
Augeneria aff. tentaculata Monro, 1930	CC
Lumbrineriopsis mucronata (Ehlers, 1908)	CC
Lumbrineris sp.	CC
Ninoe brasiliensis Kinberg, 1865	CC
Ninoe falklandica Monro, 1936	CC
Ninoe sp.	CC
Lumbrineridae unid.1	CC
Lumbrineridae unid.2	CC
OENONIDAE	
Drilonereis sp.	CC
Oenonidae unid.1	CC
Lysarete brasiliensis Kinberg, 1865	CC
OWENIIDAE	
Owenia sp.	DF/SS
SABELLARIIDAE	
Idanthyrsus armatus Kinberg, 1867	FF/SS
Sabellaria bellis Hansen, 1882	FF/SS
PECTINARIIDAE	
Cistenides ehlersi (Hessle, 1917)	DF
Pectinariidae unid.1	DF
AMPHARETIDAE	
Ampharete sp.	DF
Ampharetidae unid.1	DF
TEREBELLIDAE	
Terebellidae unid.1	DF
TRICHOBRANCHIDAE	
Terebellides lanai Solis-Weiss *et al*., 1991	DF
Trichobranchiidae unid.1	DF
SABELLIDAE	
Sabellidae unid.1	FF/SS
SERPULIDAE	
Serpulidae unid.1	FF/SS

RESULTS

Faunistic analysis

A total of 57 polychaete taxa distributed among 29 families was found (Table 2). The percentage of polychaetes which represent the fraction of the macrofauna larger than 0.5mm in the bottom samples was rather constant (20-24%) in the different habitats studied between 34ºS and 38ºS. Lumbrineridae and Onuphidae were the most diverse, with 8 and 6 taxa respectively. The highest frequency of occurrence was 44% (21 stations) for Onuphidae and 24% (13 stations) for Lumbrineridae. The other families were collected in 1-12 sampling stations.

The number of invertebrate species collected in soft bottoms was 128 and 141, during 1993 and 2001 respectively, and 118 in mussel and lemon-fish grounds during 2002. The faunistic composition of the benthic assemblages sampled in the 3 cruises showed a similar relative percentage of polychaete species. Molluscs (25-28%), Crustaceans (22-37%) and Polychaetes (20-24%) were the most diverse groups.

Polychaete assemblages

The cluster analysis produced 5 main groupings of stations (15% similarity level) and the corresponding MDS plot (Fig. 2) shows an ordination of samples according to the following areas: -the central

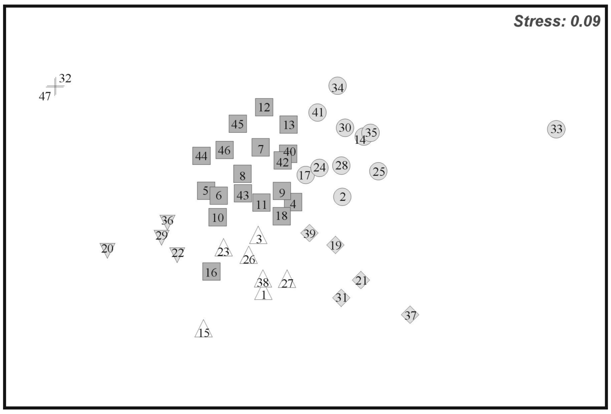

FIG. 2. – MDS ordination (Bray-Curtis similarity index) of the sampling stations based on relative abundance of polychaetes within them. Groups 1 (◇), 2 (Δ), 3 (□), 4 (O) and 5 (∇).

estuary and mouth of Río de la Plata from 8 to 27 m depth, reaching the Uruguayan coast at 39 m depth (group 1), - the coastal shelves of Uruguay (15-39 m) and Argentina (20-74 m) and the transect off the mouth of Río de la Plata, between 24 and 270 m depth (groups 2 and 3). Other coastal stations from both countries are clustered in groups 4 and 5. The results of the SIMPER test show that group 1 clusters stations (average similarity 21.40) where Polynoidae , Onuphidae and Glyceridae are the most representative taxa. Group 2 (average similarity 29.95) represents areas with *Ampharete* sp. and Serpulidae and group 3 (average similarity 15.21) with *Lagisca* sp., *Eunice argentinensis*, *Lumbrineris* sp., *Diopatra viridis, Phyllochaetopterus socialis,* and Maldanidae and Cirratulidae, as the most representative taxa. The species that contribute most to the average similarity of group 4 (35.00) are *Nephtys* sp. and *Glycera americana*, and *Onuphis tenuis* to the average similarity of group 5 (51.41). Stations 32 and 47 are characterized by Nephtyidae.

TABLE 3. – Combinations of n variables giving the largest rank Spearman correlations between biotic (4th root transformed relative abundance data, Bray-Curtis similarity) and environmental (Euclidean distance) similarity matrices (BIOENV analysis). Bold type indicates overall optimum.

n	Spearman's Correlation Coefficient (ρ_w)	Variables
1	0.205	Bottom salinity
	0.160	Bottom type
	0.011	Bottom temperature
2	**0.237**	Bottom salinity, bottom type
	0.133	Bottom temperature, bottom salinity
	0.011	Bottom temperature, bottom type
3	0.159	Bottom temperature, bottom salinity, bottom type
	-0.126	Depth, bottom salinity, bottom type
	-0.085	Depth, bottom temperature, bottom salinity
	-0.046	Depth, bottom temperature, bottom type

Environmental analysis

The matching of the environmental and faunal matrices (BIO-ENV analysis) is outlined in Table 3. No single variable provided the best correlation with biotic patterns. The abiotic variable that best explained the distribution pattern was the bottom salinity, while the best combination included 2 variables: bottom salinity and type of bottom.

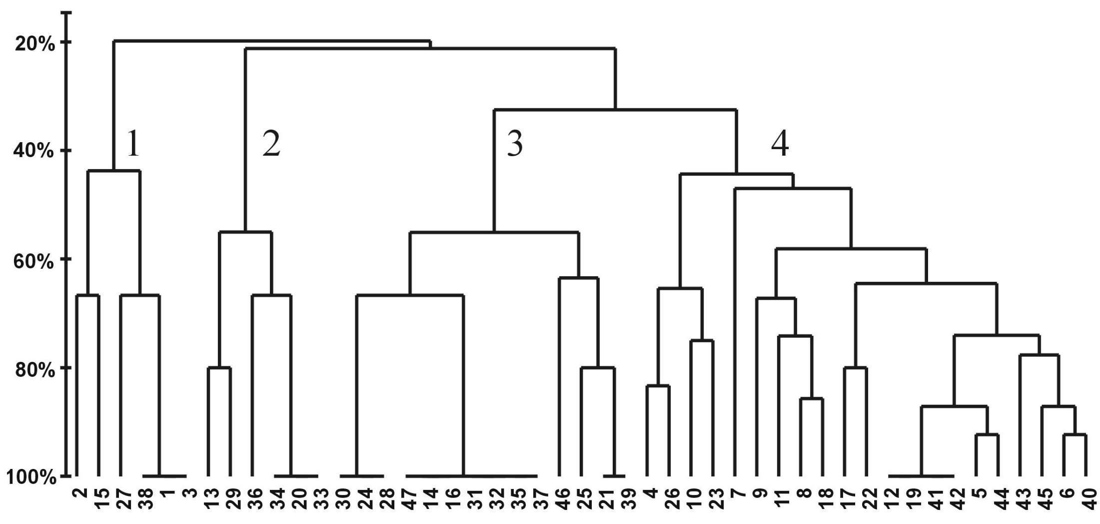

FIG. 3. – Cluster analysis of stations (Bray-Curtis similarity index) according to presence-absence of polychaete feeding types in the study area (34ºS-38ºS). (cluster 1, deposit and filter feeders; cluster 2, omnivores; cluster 3, carnivores; cluster 4, mainly carnivores and deposit-feeders with the addition of omnivores and suspension feeders).

Feeding types

The cluster analysis performed with general feeding types (carnivore, omnivore, deposit-feeder, filter/suspension-feeder) as variables shows 4 main groups at 40% similarity level (Fig. 3). Group 1 clusters uruguayan and argentinian coastal stations where deposit-feeders (Ampharetidae) and filter-feeders (Serpulidae) are prevalent. Group 2 clusters stations with omnivores (Onuphidae) from the estuarine area. Group 3 clusters other coastal stations where carnivores (Polynoidae, Glyceridae, Lumbrineridae, Nephtyidae) are conspicuously present. The sampling stations deeper than 23 m are clustered in group 4, with carnivores (Eunicidae, Lumbrineridae, Polynoidae) and deposit-feeders (Ampharetidae, Maldanidae, Cirratulidae) as the main feeding types, together with omnivores and suspension feeders.

DISCUSSION

As the sampled area included a variety of substrata ranging from consolidated sandy-gravel to soft sediments, it was not feasible to use the same sampling device. Consequently, due to this methodological constraint, the information presented here is based on the relative abundance and distribution of taxa. This contribution intends to compile information for a large area and future studies will attempt to obtain comparative quantitative samples from the different habitats, throughout the geographical range under study.

The dominance of polychaetes in a variety of macrofaunal assemblages and geographical regions is well documented, even though comparing data sets is difficult due to differences in sampling techniques, mesh size used and number of replicates (i.e Hutchings, 1998 and references). In previous studies in the region, in northern temperate latitudes (32ºS - 34ºS), the number of polychaete species reaches 36% of the total number of species collected in a large variety of bottoms between the inner shelf and the upper slope, and the number of specimens represents 48% of the total number of macroinvertebrates (Capitoli, 2002). In southern areas of the southwest Atlantic, these estimates reach 9% in sandy bottoms on the Patagonian shelf and 35% in diverse substrata in the Magellan Strait (Gambi and Mariani, 1999; Bremec *et al*., 2000).

The multivariate analysis produced 5 different clusters of stations characterized by different suites of polychaetes in the study area. The spatial distribution of these sampling stations and the results of the SIMPER analysis clearly show that, in general, the polychaete fauna from the central estuary and mouth of the river (group 1) at almost 30m depth, is different from that collected at other coastal stations (groups 2, 4 and 5). Secondly, the deeper stations are clustered in group 3 and characterized by another suite of polychaetes. The BIO-ENV analysis indicates that species are distributed mainly according to a salinity gradient and bottom type. These variables serve to explain the patterns of faunal distribution in this study area that comprises an estuarine muddy sector and sandy or gravel-sandy bottoms of the adjacent marine waters, and a few stations on the open shelf. The granulometric type is the main abiotic variable that determines the spatial distribution of polychaete assemblages in other South American systems influenced by continental waters, like Lagoa dos Patos on the south Brazilian shelf (Capitoli *et al*., 2004) and Bahía Blanca estuary on the Argentinean shelf (Elías and Bremec, 1994). The close relationship between benthic fauna and sediment type has previously been recognised in classical papers regarding spatial distribution of benthos (e.g. Thorson, 1957; Sanders, 1958; 1968; Lie and Kelley, 1970; Day *et al*., 1971) and sediment was considered as an indicator of the availability of feeding resources (Sanders *et al*., 1962; Rhoads and Young, 1970; Young and Rhoads, 1971). Recent investigations continue to show that the sediment characteristics are primary factors determining the spatial patterns of macrobenthos and polychaete assemblages (e.g. Muniz and Pires, 2000; Probert *et al*., 2001; Hernández-Arana *et al*., 2003; Rodriguez-Villanueva *et al*., 2003; Dauvin *et al*,, 2004; Díaz-Castañeda and Harris, 2004).

Mainly omnivores (Onuphidae) and carnivores (Polynoidae, Glyceridae, Lumbrineridae, Nephtyidae) characterize the different stations in the estuarine muddy areas. A variety of feeding types were found in the rest of the sandy coastal stations and in areas deeper than 23m. Studies on spatial distribution of macrobenthos in the study area show a higher biomass of deposit-feeders and carnivorous molluscs in the estuarine area and various feeding types widely distributed in the marine and open waters (Giberto *et al*., 2004). Polychaetes, as a group, reflect the trend observed for the benthic community as a whole. It was found that generally trophic diversity increased with salinity, meaning that a more even distribution of trophic structure is found at higher salinities (Gaston *et al.*, 1998), which suggests differences in the availability of resources and in the interactions of food webs (Brown *et al.*, 2000). The area studied comprises the Río de la Plata estuary and the adjacent marine coastal and open waters and little is known about trophic webs. The large estuarine zone (38,000 km^2) has both bottom and surface salinity fronts, important in fish reproductive processes and where high concentrations of zooplankton occur, and a turbidity front in the inner estuary (Mianzan *et al.*, 2001a), with high biomass of deposit-feeding bivalves (Giberto *et al.*, 2004). The whole study area is disturbed by trawling fisheries, many of the catches of which are dependent on benthic food resources. Thus future studies need to be conducted to assess the functional role of these benthic communities and in particular of polychaetes.

Our present records extend the distributional range of *Sabellaria bellis* from the mouth of the Río de la Plata estuary at 35°S (Bremec and Giberto, 2004) to 38°S (Station 7, 79 m depth), and the bathymetric range of *Travisia amadoi* from intertidal and shallow sandy bottoms (Elías *et al.*, 2003a) to depths of 125 and 270 m (Stations 9 and 8 respectively) . Additionally, the southern distribution range of two more species is extended: *Terebellides lanai*, originally described from southern Brazil (Bremec and Elías, 1999), was collected at 35°S (Station 22) and *Aglaophamus uruguayi*, described for muddy bottoms at 33°S 51°W (Orensanz and Gianuca, 1974), was collected between 35°S and 37°S, at 24 m depth (Stations 45 and 12) and in deeper sandy substrata at 125-270 m depth (Stations 9 and 8). Our study material was collected in warm temperate waters of the Argentinean Biogeographical Province (Boschi, 2000a). It includes coastal waters from latitude 43-44°S (Patagonia) reaching 23°S (southern Brazil). The Río de la Plata (35°S) is the major hydrographical feature within this province (Boschi, 2000b), and considered a significant zoogeographic barrier. However, this barrier was found to be variable for plankton and fish species, according to climatic variation and discharge patterns of the river (Mianzan *et al.*, 2001b). In the case of the decapod *Ebalia rotundata* (A. Milne Edwards, 1880), found in marine waters off Argentina and Uruguay, it was considered that both thermal and salinity tolerance could constrain the dispersal of the species from south to north and within estuarine waters respectively (Giberto and Bremec, 2003c). Local patterns of larval transport could allow the colonization of new areas from Brazil to the south and the role of the Río de la Plata regime as a biological barrier to the distribution of coastal polychaete fauna between Uruguay and Argentina still has to be assessed. More frequent sampling and detailed examination of the polychaetes will almost certainly lead to new records and provide more detailed distributional patterns.

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